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Unveiling details of the dry-leaf praying mantids: Insights into two species of *Decimiana* (Mantodea, Acanthopidae) and new records for Mato Grosso do Sul, Brazil

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Abstract

Acanthopidae is the third most diverse family within the Neotropical praying mantids with its genera presenting a high similarity with dry leaves in different levels of senescence or lichens and moss. It has nine genera that have received numerous taxonomic treatments throughout the history of Neotropical mantises' studies. One of those genera, *Decimiana* Uvarov, 1940, was revised by Lombardo (2000) and, since then, three species have been added to the genus. In this study, we recorded two species of dry-leaf praying mantids, *Decimiana tessellata* (Charpentier, 1841) and *Decimiana hebardi* Lombardo, 2000, for the first time for Mato Grosso do Sul state in Midwest Brazil. A description of male genitalia of both species is provided, and the female genitalia of both species are described for the first time, setting the bases for taxonomic comparison across Neotropical Mantodea lineages, contributing to systematics and phylogenetic discussions.

Keywords

Biodiversity, dimorphism, distribution, diversity, genitalia, morphology, neotropics, taxonomy

Introduction

The study of Neotropical mantids has been increasing in recent decades (Rivera 2010). Specifically, the last 20 years have been characterized by descriptions of new species and genera (e.g., Agudelo 2014, Svenson and Rodrigues 2019, Agudelo et al. 2019, Rivera et al. 2020, Moulin and Schwarz 2023, Ferraz et al. 2023, 2025) and revisions of described genera (e.g., Scherrer 2014, Svenson 2014, Rodrigues and Cancello 2016, Favacho et al. 2023).

After Thespidae (144 spp.) and Photinaidae (43 spp.), Acanthopidae is the third most diverse family, also being one of the more extensively studied taxa within the Acanthopoidea, with fully revised genera and occasional treatments of individual species (Rivera and Svenson 2020). The family has 42 species distributed in 9 genera: *Acanthops* Audinet-Serville, 1831 (14 spp.); *Decimiana* Uvarov, 1940 (7 spp.); *Lagrecacanthops* Roy, 2004 (2 spp.); *Metacanthops* Agudelo & Maldaner, 2019 (2 spp.); *Metilia* Stål, 1877 (4 spp.); *Plesiacanthops* Chopard, 1913 (5 spp.); *Parvacanthops* Schwarz & Moulin, 2023 (1 spp.); *Pseudacanthops* Saussure, 1870 (6 spp.); and *Royacanthops* Schwarz & Moulin, 2023 (2 spp.).

The genus *Decimiana* is a group of dead-leaf praying mantids endemic to the Neotropical region. The genus was revised by Lombardo (2000) and, since then, three species have been added: *D. clavata* Ippolito & Lombardo, 2004; *D. elliptica* Menezes & Bravo, 2012; and *D. gaucha* Maldaner & Rafael, 2017. Although a thorough review has been conducted, and further assessments on species distributions and morphology have been added (Maldaner and Rafael 2017), there are still species in this genus known only by one of its sexes. In addition to the lack of intersexual variability documentation, descriptions usually lack reference images for external morphology and genitalia, which is a complicator in a genus with high morphological similarity.

No females of the genus have had their genitalia described, except for a *Decimiana* species portrayed in Heitzmann-Fontenelle (1964), misidentified as *Acanthops erosula* Stål, 1877. The species portrayed by Heitzman-Fontenelle (1964) could be *D. hebardi* or *D. bolivari*, but both are very similar, and assessment of the specimens is necessary. Although Heitzmann-Fontenelle (1964) has illustrated the female genitalia, its description is summed as being very similar to *Acanthops falcataria* (Goeze, 1778). The genitalia of *A. falcataria* on the other hand was described in detail earlier by the same author (Heitzmann 1962), being the exception among Acanthopidae.

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Rivera and Svenson (2020) noted that in sexually dimorphic taxa such as the genera within Acanthopidae, half of the species are known by only one sex, and the incomplete assessment of Acanthopidae morphology has led to uncertainty in species delimitation. This historical practice has resulted in the placement of congeneric sexes under different species or genera. In many mantid taxa, this situation is present in different families, such as *Acontista* Saussure & Zehntner, 1894 (Acontistidae) and *Chloromiopteryx* Giglio-Tos, 1915 (Thespidae) (see Roy 2006 and Agudelo and Rivera 2015, respectively). Rivera (2010) noted that the description of both sexes in terms of intraspecific and intersexual variability should be the ideal, especially in highly dimorphic taxa.

The present work describes for the first time the female genitalia and redescribes the male genitalia in two species of the genus *Decimiana*: *D. tessellata* (Charpentier, 1841) and *D. hebardi* Lombardo, 2000. Reference images of the male and female external morphology and genitalia are provided along with the documentation of intraspecific variability, measurements, and a new record for a Brazilian state.

Material and methods

This study was based on 21 specimens (4♂, 5♀, 12 nymphs) and 2 oothecae belonging to the Coleção Zoológica (Zoological Collection) of the Universidade Federal de Mato Grosso do Sul (ZUFMS). Specimens were identified using Lombardo's (2000) revision of *Decimiana* and subsequent contributions (Ippolito and Lombardo 2004, Menezes and Bravo 2012, Maldaner and Rafael 2017).

The dissection procedures followed Brannoch et al. (2017) and Ferraz and Souza-Dias (2025). Initially, the terminalia were submerged in heated water (between 80–100°C) for 15 minutes, after which the phallic complex was extracted using a hypodermic needle. Subsequently, the genital structures were clarified in warmed 10% KOH followed by neutralization with acetic acid. Finally, each component of the phallic complex was dissected individually. The dissected genital parts were stored in 1.5 mL microtubes containing glycerin. The external morphology and nomenclature of the phallic complex adhere to Brannoch et al. (2017) with additions by Schwarz and Roy (2019).

Abbreviations for morphology and measurements taken from specimens are as follows:

Male genitalia morphology.—**afa** – anterior process (left phallomere); **fda** – main posterior lobe (right phallomere); **L4A** – sclerite extended on the ventral wall; **L4B** – sclerite extended on the dorsal wall; **loa** – posteromesal; **paa** – posterior process of the left phallomere; **pia** – posterolateral process to pva; **pva** – anteromesal process to pia; **sdp** – secondary distal process.

Female genitalia morphology.—**agsl** – accessory gland supporting the lobe; **CG8** – caudogyne; **CX8** – coxa 8; **cxal** – anteromesal coxal lobe; **cxvl** – ventrolateral coxal lobe; **cxdl** – dorsolateral coxal lobe; **gl9** – gonoplate 9; **gp8** – gonapophysis 8; **gp9** – gonapophysis 9; **gpal8** – apical lobe of gonapophysis 8; **gpmo8** – medial growth of gonapophysis 8; **rh** – rachis; **sbu** – spermathecal bulge; **sbp** – spermathecal bulb.

Measurements.—**AcL** – length of anterocoxa; **AfL** – length of anterofemur; **AfW** – Width of anterofemur; **AtSL** – length of anterotibia with spur; **BL** – body length; **ClyL** – length of clypeus; **ClyW** – width of clypeus; **HW** – head width; **HL** – head length; **LfL** – length of lower frons; **LfW** – width of the lower frons; **MaxW** – maximum pronotum width; **MinW** – minimum pronotum width; **MscL** – length of mesocoxa; **MsfL** – length of mesofemur; **MtcL** – length of metacoxa; **MtfL** – length of metafemur; **MttL** – length of the metatibia; **MzL** – length of the metazone; **PnL** – length of pronotum; **PzL** – length of the prozone; **TL** – total length; **WaL** – length of anterior wing; **WaW** – width of anterior wing; **WpL** – length of posterior wing; **WpW** – width of posterior wing.

A Leica M205C auto-stacking stereomicroscope coupled with a Leica MC190 HD camera and a Nikon D3200 coupled with a Nikkor micro 60 mm macro lens were used to photograph the specimens. Measurements were taken using the same equipment and the Leica Application Suite X in the Departamento de Entomologia (Entomology Department) of the Museu Nacional (MNRJ). Figures and illustrations were assembled using Photoshop CS6 software.

Results

Two species of *Decimiana* were identified: *D. hebardi* Lombardo, 2000 (3♂, 1♀) and *D. tessellata* (Charpentier, 1841) (1♂, 2♀, 11 nymph, 2 ooth) (Fig. 1). Most nymphs were acquired from two oothecae from one female *D. tessellata* (Fig. 2). One specimen—a female nymph from a different locality [ZUFMS-MAN00028]—could not be identified to a species level but its geographical record is added to the distributional map.

The only male specimen of *D. tessellata* is considerably larger than those of *D. hebardi*, while both males are larger than their conspecific females. The females of *D. tessellata* are only slightly larger than those of *D. hebardi*, and their size difference is not as conspicuous as the males of the two species. Measurements for all specimens are provided in Table 1.

We record for the first time the presence of *D. tessellata* and *D. hebardi* for Mato Grosso do Sul State in Midwest Brazil. The genus is recorded for seven municipalities in the state (Table 2) comprising two distinct biomes, the Cerrado and the Pantanal: Aquidauana, Campo Grande, Corguinho, Corumbá, Coxim, Jaraguari, and Porto Murtinho. A map with complete geographical record for those two species concatenating both literature records and our new records can be observed in Fig. 7. All records are listed after respective literature.

Class Insecta Linnaeus, 1758
Order Mantodea Latreille, 1802
Family Acanthopidae Burmeister, 1838

Genus *Decimiana* Uvarov, 1940

Type species.—*Acanthops tessellata* Charpentier, 1841 (by monotypy).

***Decimiana tessellata* (Charpentier, 1841)**

Type material.—NEOTYPE: BRAZIL • 1♂; Mato Grosso, Chapada; coll. Brunner; ANSP (not examined).

Material examined.—BRAZIL • 1♂; Mato Grosso do Sul, Porto Murtinho, Retiro Ingá; 21°27'19.6"S, 57°04'45.9"W; 24 Jul. 2022; T. R. F. Sinani & G. Saturno; ZUFMS-MAN00014; ZUFMS • 1♀, 11 nymphs, 2 Ooths; Mato Grosso do Sul; 2014–2016; R. S. Olivier; ZUFMS-MAN00025; ZUFMS • 1♀; Mato Grosso do Sul, Corguinho, Taboco; 19°46'28.5"S, 55°14'40.7"W; 18 Jan. 2016; M. H. Justino; ZUFMS-MAN00033; ZUFMS • 1♀; Mato Grosso do Sul,

Table 1. Measurements of analyzed specimens of *D. tessellata* and *D. hebardi* from Mato Grosso do Sul.

Measurements	*Decimiana tessellata* [ZUFMS-MAN00014]	*Decimiana tessellata* [ZUFMS-MAN00025]	*Decimiana tessellata* [ZUFMS-MAN00033]	*Decimiana tessellata* [ZUFMS-MAN00037]	*Decimiana hebardi* [ZUFMS-MAN00017]	*Decimiana hebardi* [ZUFMS-MAN00013]	*Decimiana hebardi* [ZUFMS-MAN00034]	*Decimiana hebardi* [ZUFMS-MAN00027]
Sex	♂	♀	♀	♀	♂	♂	♀	♀
CT	60.564	34	33.727	31.024	41.922	42.317	28.748	30.473
CC	51.733	34	33.727	31.024	35.38	35.638	28.748	30.473
CPz	4.154	4.185	3.589	3.681	2.791	2.844	3.434	3.149
CMz	9.65	8.007	7.591	6.853	7.19	7.167	6.777	6.799
Lmax	4.312	4.491	4.18	4.191	3.106	2.931	3.75	3.922
Lmin	2.598	2.566	2.091	2.191	1.832	1.596	1.97	2.11
CaC	9.164	8.495	8.664	8.519	7.177	6.391	6.588	7.504
CaF	11.3	11.065	11.042	10.182	8.885	8.542	9.506	9.441
LaF	2.831	3.044	3.096	2.57	2.133	2.006	2.627	2.822
CaTc	7.602	7.002	7.051	6.38	5.768	6.004	5.952	6.037
CmC	3.38	2.578	2.971	2.963	2.572	2.548	2.926	2.773
CmF	7.072	5.533	5.429	5.637	4.832	4.856	5.464	4.877
CmT	6.006	6.306	5.471	5.076	4.429	4.544	5.178	4.55
CpC	4.174	3.841	–	3.896	3.01	3.202	2.951	2.538
CpF	8.404	6.993	–	7.058	5.596	6.031	6.391	5.532
CpT	8.88	7.922	–	7.579	5.706	6.164	6.833	6.753
CCb	3.726	3.596	3.639	3.947	2.962	2.759	3.758	3.757
LCb	6.13	5.767	5.754	6.117	4.88	4.842	5.804	5.573
CEf	1.053	0.991	0.979	1.109	0.829	0.665	0.967	0.902
LEf	2.461	2.45	2.672	2.623	1.935	1.527	2.477	2.256
CCp	0.984	0.876	0.9	1.03	0.753	0.552	1	0.927
LCp	1.664	1.775	1.799	1.87	1.377	1.296	1.654	1.641
CAa	44.796	–	–	–	30.189	30.335	17.692	16.127
LAa	11.162	–	–	–	7.162	7.197	6.129	–
CAp	42.971	–	–	–	27.507	29.113	13.336	–
LAp	24.262	–	–	–	14.794	15.79	7.157	–
Ratios								
LCb/CCb	1.645	1.604	1.581	1.55	1.648	1.755	1.544	1.483
LEf/CEf	2.337	2.472	2.729	2.365	2.334	2.296	2.562	2.501
CPn/LMax	3.201	2.715	2.675	2.513	3.213	3.416	2.723	2.536
CPn/Lmin	0.43	0.523	0.473	0.537	0.388	0.397	0.507	0.463
CMz/CPz	2.323	1.913	2.115	1.862	2.576	2.52	1.974	2.159
CaC/CPn	0.664	0.697	0.775	0.809	0.719	0.638	0.645	0.754
CaF/LaF	3.992	3.635	3.567	3.962	4.165	4.258	3.619	3.345
CaF/CaC	1.233	1.303	1.274	1.195	1.238	1.337	1.443	1.258

Campo Grande; 20°30'23.0"S, 54°36'51.4"W; 24 Jan. 2017; U. M. Monteiro, J. Chamorro-Rengifo, R. S. Olivier & P. J. Costa-Pinto; ZUFMS-MAN00037; ZUFMS.

Literatura records.—**Lombardo (2000)**: **BRAZIL** • 2♂, 4♀; Mato Grosso; ANSP • 1♀; Mato Grosso, Chapada do Parecis; 05 Apr. 1994; M. H. Carmois; MNHP • 2♂; Goiás, Santa Cruz de Goiás; ANSP. **PARAGUAY** • 1♂; Sapucay; 15 Feb. 1905; Foster; ANSP. **Maldaner & Rafael (2017)**: **BRAZIL** • 1♂; Brasília, Distrito Federal; 15°46'48"S, 47°55'45"W; Mar. 1968; I & G. col.; INPA • 1♂; Maranhão, Mirador, Parque Estadual Mirador, Posto Avançado do Mel; 06°43'50"S, 44°58'59"W; 18–25 Mar. 2012; F. Limeira-de-Oliveira, T. T. A. Silva & T. M. A. Lima leg.; CZMA • 1♂; Maranhão, Mirador, Parque Estadual Mirador, Base da Geraldina; 23–31 Oct. 2006; J. C. Silva leg.; CZMA • 1♂; Maranhão, Mirador, Parque Estadual Mirador; 30 Jun.–03 Jul. 2008; M.J. Almeida-Holanda leg.; CZMA • 1♂; Maranhão, Mirador, Parque Estadual Mirador; 27 Oct.–01 Nov. 2008; M. B. Aguiar Neto & A. L. Costa leg.; CZMA • 1♂; Maranhão, Mirador, Parque Estadual Mirador; 21–26 Aug. 2006; F. Limeira-de-Oliveira leg.; CZMA • 1♂; Rio Grande do Sul, Fagundes Varela; 28°51'17"S, 51°41'35"W; 05 Sep. 1978; O. Balestrian leg.; PUCRS • 1♂; Rio Grande do Sul, Pelotas; 31°46'19"S, 52°20'33"W; Nov. 1995; Dalmolinis leg.; MECB. **Rivera & Svenson (2020)**: **BRAZIL** • 1♂; Goiás, Mineiros, Parque Nacional das Emas; Jun.–Jul. 2003; S. Astete leg.; UNALM • 2♂; Paraná, Arapoti; Dec. 1944; A. Maller leg.; AMNH • 1♂; Santa Catarina, Corupá; Aug. 1946; A. Maller leg.; AMNH. **PARAGUAY** • 1♀; Sapucay; 15 Feb. 1901; W. T. Foster leg.; AMNH • 1♀+; Sapucay; 2 Oct. 1903; W. T. Foster leg.; AMNH • 1♀; Sapucay; W. T. Foster leg.; USNM • 1♀; Cacupé; H. L. Parker leg.; USNM.

Male genitalia: Ventral phallomere (Fig. 5A) rectangular, longer than wide, margins oval, lower margin sclerotized, **L4A** smooth; **sdp** tapered, well sclerotized, tip slightly curving upward, in dorsal view displaced towards left margin; left upper margin with tapered **bl** in dorsal view, well sclerotized, inner margin facing the distal portion of the genitalia toothed. Left phallomere (Fig. 5C) with

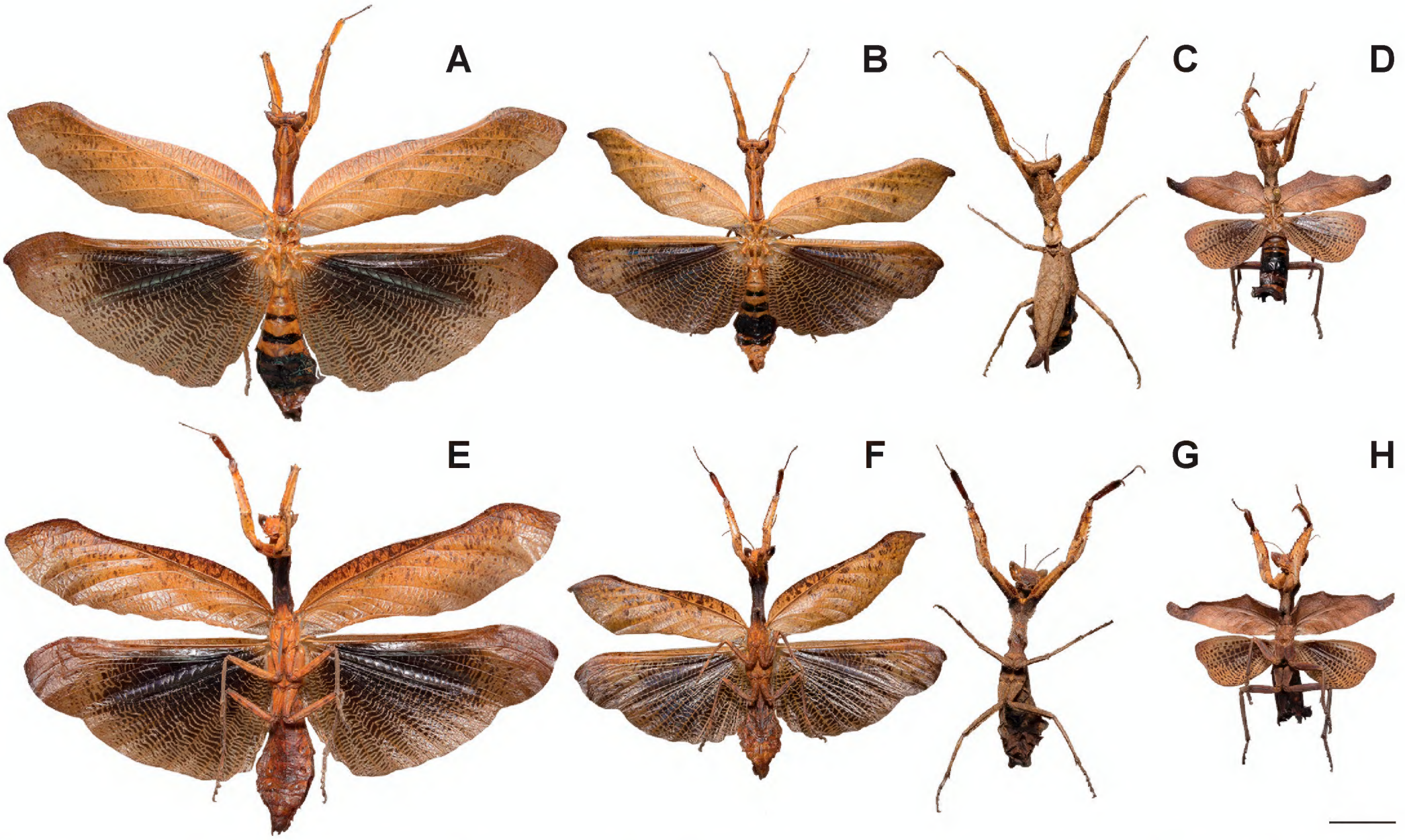

Fig. 1. Individuals of *Decimiana tessellata* and *Decimiana hebardi*. **A, E.** Male *D. tessellata* [ZUFMS-MAN00014]; **B, F.** Male *D. hebardi* [ZUFMS-MAN00017]; **C, G.** Female *D. tessellata* [ZUFMS-MAN00037]; **D, H.** Female *D. hebardi* [ZUFMS-MAN00034]. **A–D.** Dorsal view; **E–H.** Ventral view. Scale bar: 10 mm.

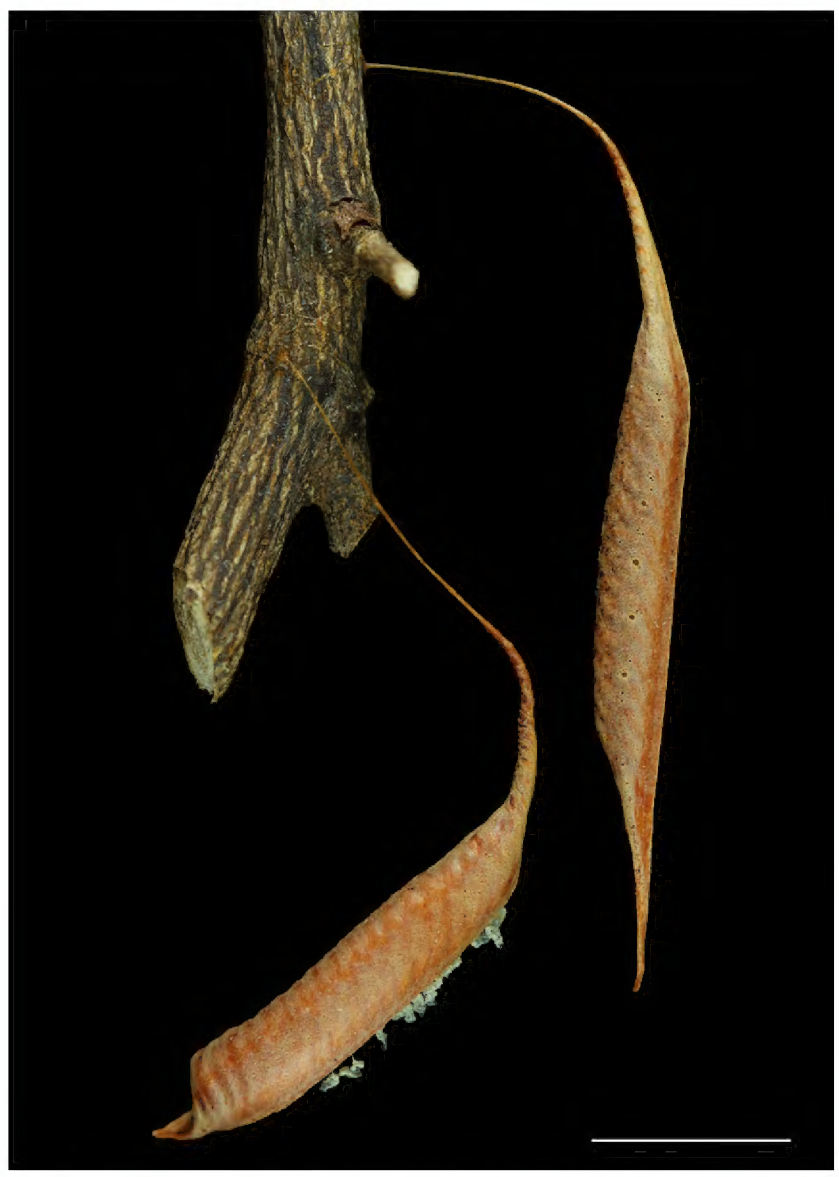

Fig. 2. Oothecae of *Decimiana tessellata* obtained from one of the females. Scale bar: 10 mm.

L4B broad, sclerotized, with anterior portion membranous, covered in small sclerotized bristles, lower margin more sclerotized than the rest of **L4B**; **afa** displaced upwards, elongated, anterior portion covered in conical spiniform projections, irregularly indented distally; **loa** rounded, membranous, with longer bristles; **paa** robust, curved upwards, bristles scattered along its length, denser at tip. Right phallomere (Fig. 5E) broad, **fda** projected with several bristles; **bm** membranous; **R3** short, broad, **an** inconspicuous; **pia** and **pva** isometric, with broad bases, tips tapering, curved, strongly indented on the inner face; **pia** attached to membranous portion of right phallomere; **pva** not attached, facing inner portion of the genitalia.

Female genitalia: **CG8** trapezoidal, well sclerotized, with profound indentation proximally, **CG8** with profound constriction before **sbu**, **sbu** square-shaped with variably invaginated lateral margins, distal margin curved inwards (Fig. 6A); **CX8** well sclerotized toward the inner margin, at the level of **sbu** inner margins bend (Fig. 6A); **cxaI** with wrinkled appearance caudally, with villi-shaped margins, stretching distally to the **cxvI**, **cxvl** curving, bending inwards to **sbu**, then bending again distally directing to **gp8** (Fig. 6A); **agsl** distinguishably sclerotized (Fig. 6A); **gp8** elongated, sinuous, bearing a variable number of bristle-like setae proximally close to **gpmo8** (Fig. 6C); **gpmo8** small, sclerotized, at middle way of **gp8** where the setae end (Fig. 6C); **gpal8** bifurcated, upper margin broader but shorter, with stippled texture, lower margin narrower but longer, same texture but a few bristles at apex (Fig. 6C, E); **gp9** elongated, smooth, bare; **rh** oval, short, sclerotized (Fig. 6A); **gl9** slightly broader than **gp8**, bare with small setae distally (Fig. 6C).

Decimiana hebardi **Lombardo & Ippolito, 2000**

Type material.—HOLOTYPE: BOLIVIA 1♂; Santa Cruz de la Sierra; J. Steinbach; ANSP (not examined).

Material examined.—BRAZIL • 1♂; Mato Grosso do Sul, Aquidauana, Taunay; 20°05'55.8"S, 56°00'38.9"W; 11 May 2022; T. R. F. Sinani & S. Keuroghlian-Eaton; ZUFMS-MAN00013; ZUFMS • 1♂; Mato Grosso do Sul, Corumbá, Pantanal da Nhecolândia;

Table 2. Localities of the new records of *Decimiana* spp. in Mato Grosso do Sul (MS). List of analyzed material and details on each specimen can be found in "Records in literature".

Species	Country	State	Municipality	Specific locality	Latitude, Longitude
Decimiana hebardi	Brazil	MS	Aquidauana	Taunay	20°05'55.8"S, 56°00'38.9"W
Decimiana hebardi	Brazil	MS	Corumbá	Pantanal da Nhecolândia	18°59'17.4"S, 56°37'08.9"W
Decimiana hebardi	Brazil	MS	Corumbá	Pantanal do Miranda	19°34'36.62"S, 57°01'10.31"W
Decimiana hebardi	Brazil	MS	Coxim	Pesqueiro Cachoeira das Palmeiras II	18°21'44.80"S, 54°36'52.85"W
Decimiana hebardi	Brazil	MS	Campo Grande	Reserva da Base Aérea	20°28'21.1"S, 54°39'20.8"W
Decimiana tessellata	Brazil	MS	Porto Murtinho	Retiro Ingá	21°27'19.6"S, 57°04'45.9"W
Decimiana tessellata	Brazil	MS	Corguinho	Taboco	19°46'28.5"S, 55°14'40.7"W
Decimiana tessellata	Brazil	MS	Campo Grande	RPPN UFMS	20°30'23.0"S, 54°36'51.4"W
Decimiana sp.	Brazil	MS	Jaraguari	Furnas do Dionísio	20°09'48.62"S, 54°33'39.56"W

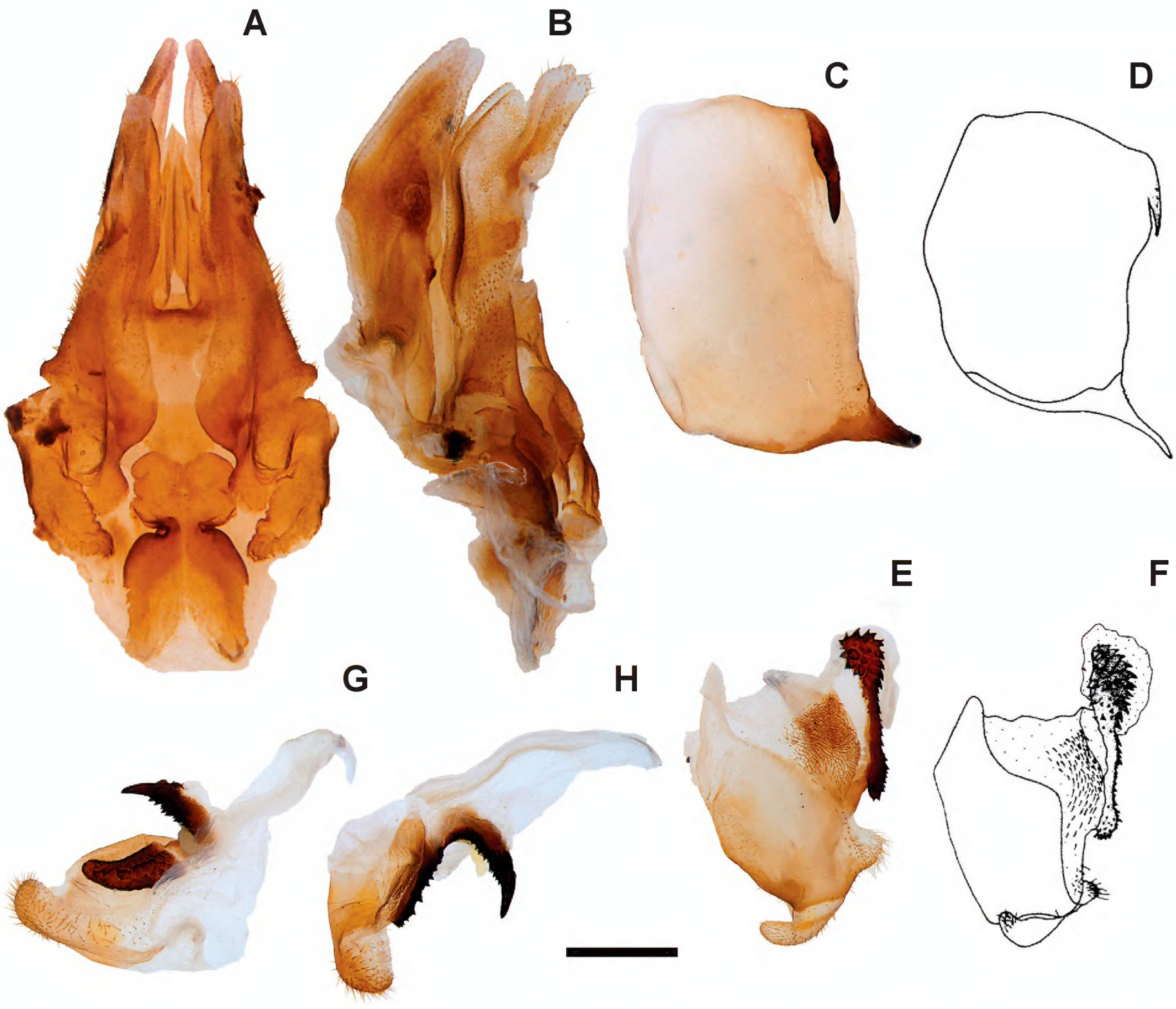

Fig. 3. *Decimiana tessellata*, female genitalia. **A.** Ventral view; **B.** Lateral view. Same species, male genitalia. **C.** Ventral phallomere, dorsal view; **D.** Same, illustration adapted from Lombardo (2000); **E.** Left phallomere, dorsal view; **F.** same, illustration adapted from Lombardo (2000); **G.** Right phallomere, ventral view; **H.** Right phallomere, lateral view. Scale bar: 1 mm.

18°59'17.4"S, 56°37'08.9"W; 26 Mar. 2022; T. R. F. Sinani; ZUFMS-MAN00017; ZUFMS • 1♂; Mato Grosso do Sul, Corumbá, Pantanal do Miranda; 19°34'36.62"S, 57°01'10.31"W; 18 Sep. 2015; R. S. Olivier, J. Chamorro-Rengifo & U. M. Monteiro; ZUFMS-MAN00026; ZUFMS • 1♀; Mato Grosso do Sul, Coxim; 18°21'44.80"S, 54°36'52.85"W; 07 Nov. 2015; R. S. Olivier & U. M. Monteiro; ZUFMS-MAN00027; ZUFMS • 1♀; Mato Grosso do Sul, Campo Grande; 20°28'21.1"S, 54°39'20.8"W; 11 Feb. 2016; L. E. Colonhezi; ZUFMS-MAN00034; ZUFMS.

Literature records.—**Lombardo (2000): BOLIVIA** • 3♂; Santa Cruz de la Sierra; J. Steinbach; ANSP • 2♂, 2♀; Buenavista; J. Steinbach; ANSP • 6♂, 20♀; Província del Sara; J. Steinbach; ANSP • 1♀; Santiago; Feb. 1959; ANSP • 1♂; Cochabamba; 30 Sep. 1952; Zischka leg.; ZSM• 1♂; Cochabamba; 07 Oct. 1950; Zischka leg.; ZSM • 1♂; Cochabamba; 04 Feb.1960; Zischka leg.; ZSM • 1♂; Puerto Suarez; 08 Nov. 1909; J. Steinbach leg.; ANSP. **Maldaner & Rafael (2017)**: **BRAZIL** • 1♂; Mato Grosso, Chapada dos Guimarães, Manso; 15°27'10"S, 55°44'21"W; 01 Dec.1988; I.R. D. Rocha; INPA • 1♂; Mato Grosso, Chapada dos Guimarães, Poconé, Fazenda Ipiranga; 16°23'06"S, 56°35'28"W; 02 May 2006; J. A. Rafael & F. F. Xavier F° leg.; INPA.

Male genitalia: Ventral phallomere (Fig. 5B) rectangular, longer than wide, margins oval, lower margin sclerotized, **L4A** smooth; **sdp** tapered, well sclerotized, displaced to left margin in dorsal view; upper margin with tapered **bl** on the left side in dorsal view, well sclerotized, inner margin toothed, facing distal portion of genitalia. Left phallomere (Fig. 5D) with **L4B** broad, sclerotized, with membranous anterior portion with small sclerotized bristles, lower margin more sclerotized than rest of **L4B**, margin near **loa** with conspicuous indentation; **afa** displaced upwards, elongated, wider at tip and tapering toward its base, densely covered with small bristles along entire length; **loa** projected, rounded, membranous, with longer bristles than rest of phallomere; **paa** curved upwards, with sparse bristles. Right phallomere (Fig. 5F) slender, **fda** projected with several bristles; **bm** membranous; **R3** short, wide, **an** inconspicuous; **pia** and **pva** with broad bases, progressively tapering, curved, strongly indented on the inner face; **pia** larger than **pva**, seemingly attached to membranous portion of right phallomere; **pva** not attached, facing inner portion of genitalia.

Female genitalia: **CG8** trapezoidal, well sclerotized, with shallow indentation proximally, **CG8** with profound constriction before **sbu**, **sbu** square-shaped with smooth margins and round edges (Fig. 6B); **CX8** well sclerotized towards inner margin with bending in inner margins near **sbu** (Fig. 6B); **cxaI** with wrinkled appearance caudally, stretching to **cxvI**, **cxvl** bending inwards to **sbu**, then bending again distally to **gp8** (Fig. 6C); **agsl** sclerotized (Fig. 6C); **gp8** elongated, sinuous, bearing a variable number of bristle-like setae proximally near **gpmo8** (Fig. 6D); **gpmo8** small, sclerotized, at middle way of **gp8** where the setae end (Fig. 6D); **gpal8** bifurcated, upper margin broader, stout, with very short

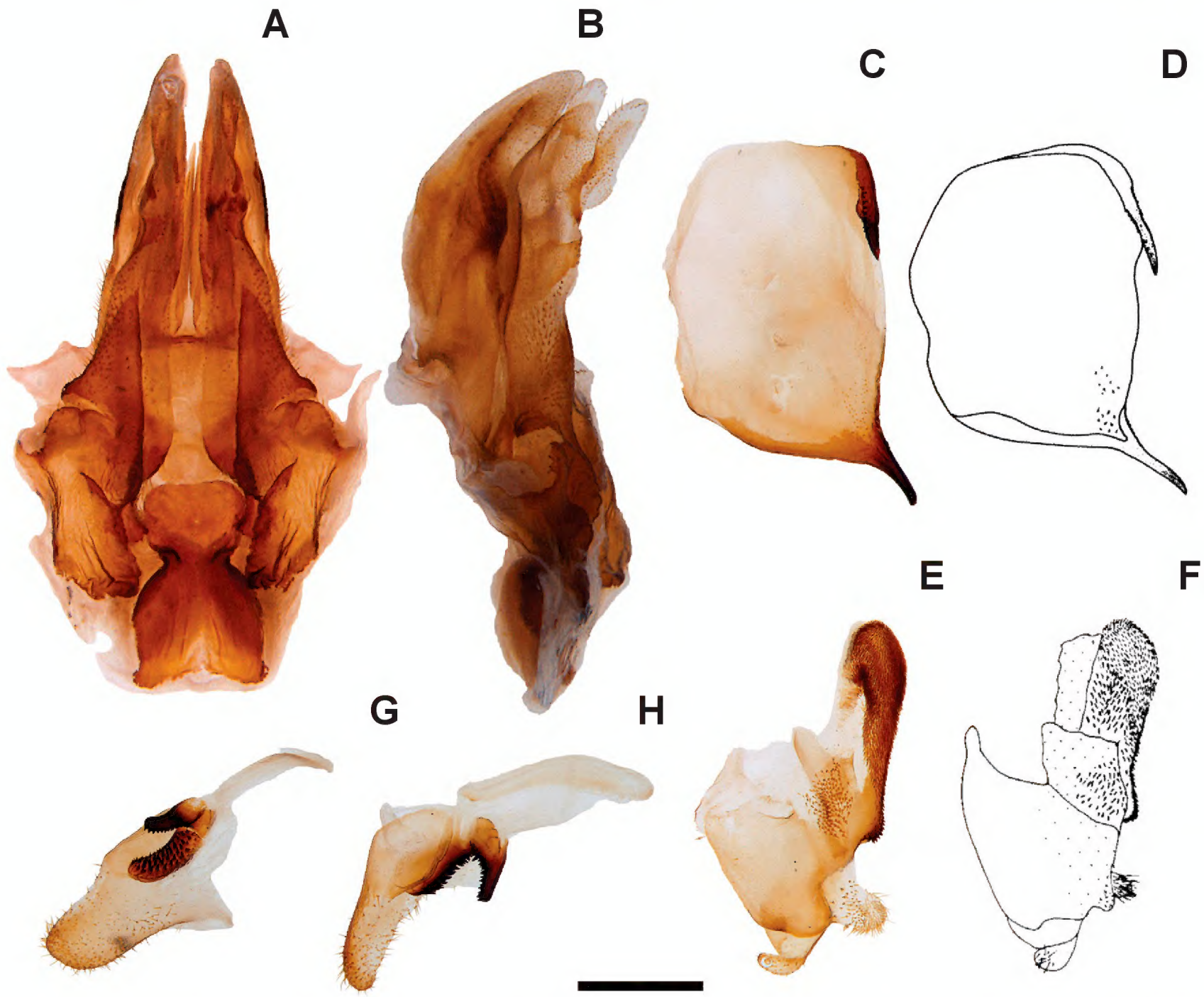

Fig. 4. *Decimiana hebardi*, female genitalia. **A.** Ventral view; **B.** Lateral view. Same species, male genitalia. **C.** Ventral phallomere, dorsal view; **D.** Same, illustration adapted from Lombardo (2000); **E.** Left phallomere, dorsal view; **F.** Same, illustration adapted from Lombardo (2000); **G.** Right phallomere, ventral view; **H.** Right phallomere, lateral view. Scale bar: 1 mm.

apex and stippled texture, lower margin narrower but longer, with same texture but few bristles at apex (Fig. 6D, F); **gp9** elongated, smooth, bare; **rh** inconspicuous (Fig. 6B); **gl9** slightly broader than **gp8**, bare with small setae distally (Fig. 6D).

Decimiana **sp. Uvarov, 1940**

Examined material.—**BRAZIL** • 1 nymph; Mato Grosso do Sul, Jaraguari; 20°09'48.62"S, 54°33'39.56"W; 23 Dec. 2015; R. S. Olivier, J. Chamorro-Rengifo & U. M. Monteiro; ZUFMS-MAN00028; ZUFMS.

Discussion

The male genitalia of *Decimiana* species vary considerably, making it easy to identify adults. The amount of assessment of male genital morphology and its illustrations puts knowledge of the genus one step ahead of that of the majority of other Acanthopoidea genera, as many are known only from the original descriptions. Although these descriptions include illustrations, these illustrations rarely depict the array of morphological variation in this genus, and such subtle variations are often more clearly visible in pictures.

The absence of described female genitalia in Acanthopidae species (and in Mantodea in general) makes comparisons difficult. Brannoch and Svenson (2016) assessed this issue while investigating the Afrotropical genera *Nilomantis* Werner, 1907 and *Ilomantis* Giglio-Tos, 1915, two taxa with extremely similar external morphology. These authors provide a historical perspective of how the male genitalia has been included and almost mandatory for generic and specific taxa delimitations, but the female genitalia have been underused as a source of taxonomic data (for examples of female genitalia inclusion, see Chopard 1920, Bugnion 1923, La Greca and Rainone 1949, Heitzmann 1959, 1962, Heitzmann-Fontenelle 1964, 1965, 1968, Favacho et al. 2023, Ferraz et al. 2023, Ferraz and Souza-Dias 2025).

Brannoch and Svenson (2016) identified characters in the female genitalia of both genera that supported recognition of the previously synonymized *Ilomantis* as a valid genus. Along with other morphological data, they described a new species, *Ilomantis ginsburgae* Brannoch & Svenson, 2016, and successfully distinguished the species of *Nilomantis* and *Ilomantis*. These results

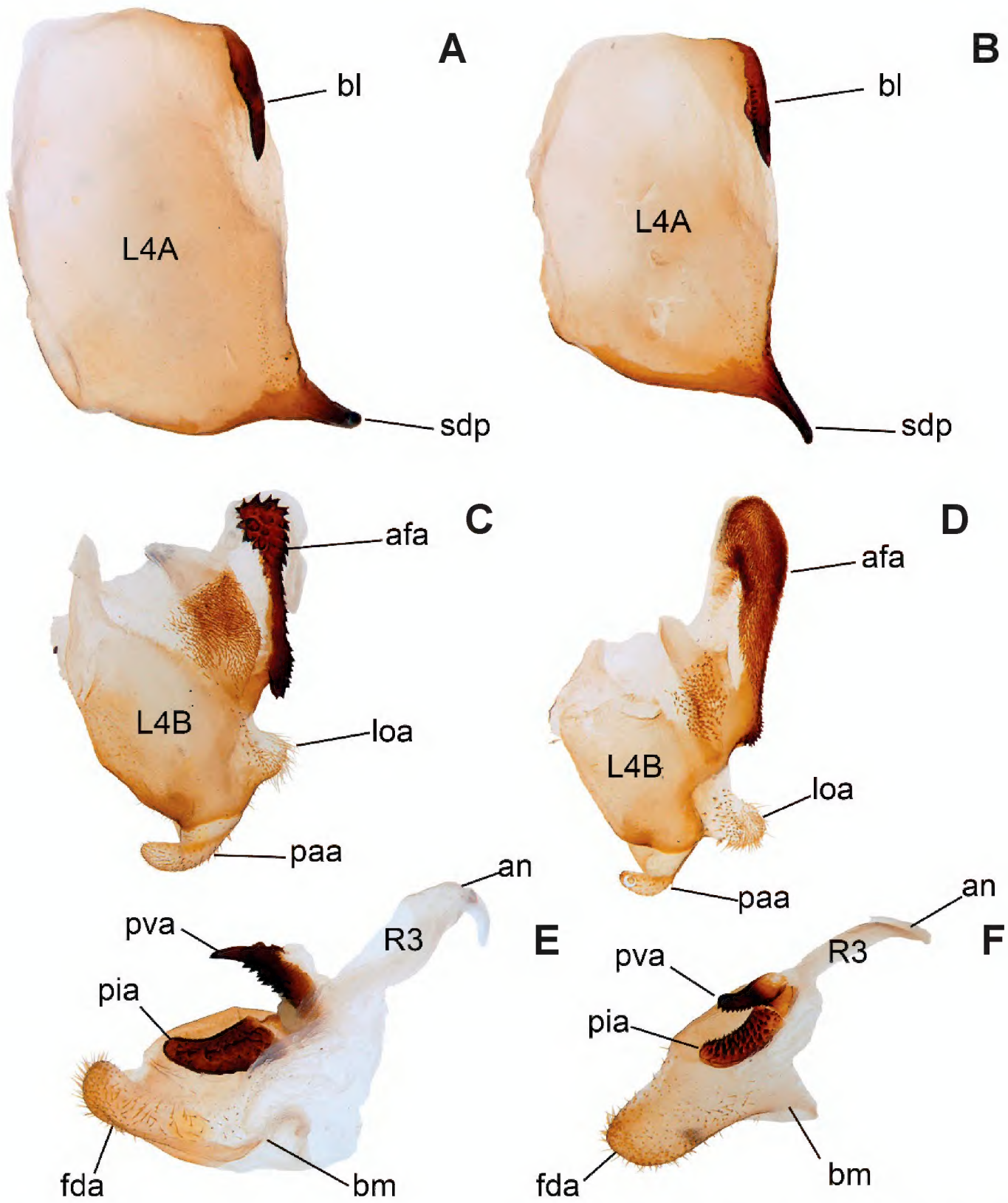

Fig. 5. Male genitalia of species of *Decimiana*. **A.** *D. tessellata* ventral phallomere, dorsal view; **B.** *D. hebardi* ventral phallomere, dorsal view; **C.** *D. tessellata* left phallomere, dorsal view; **D.** *D. hebardi* left phallomere, dorsal view; **E.** *D. tessellata* right phallomere, ventral view; **F.** *D. hebardi* right phallomere, ventral view.

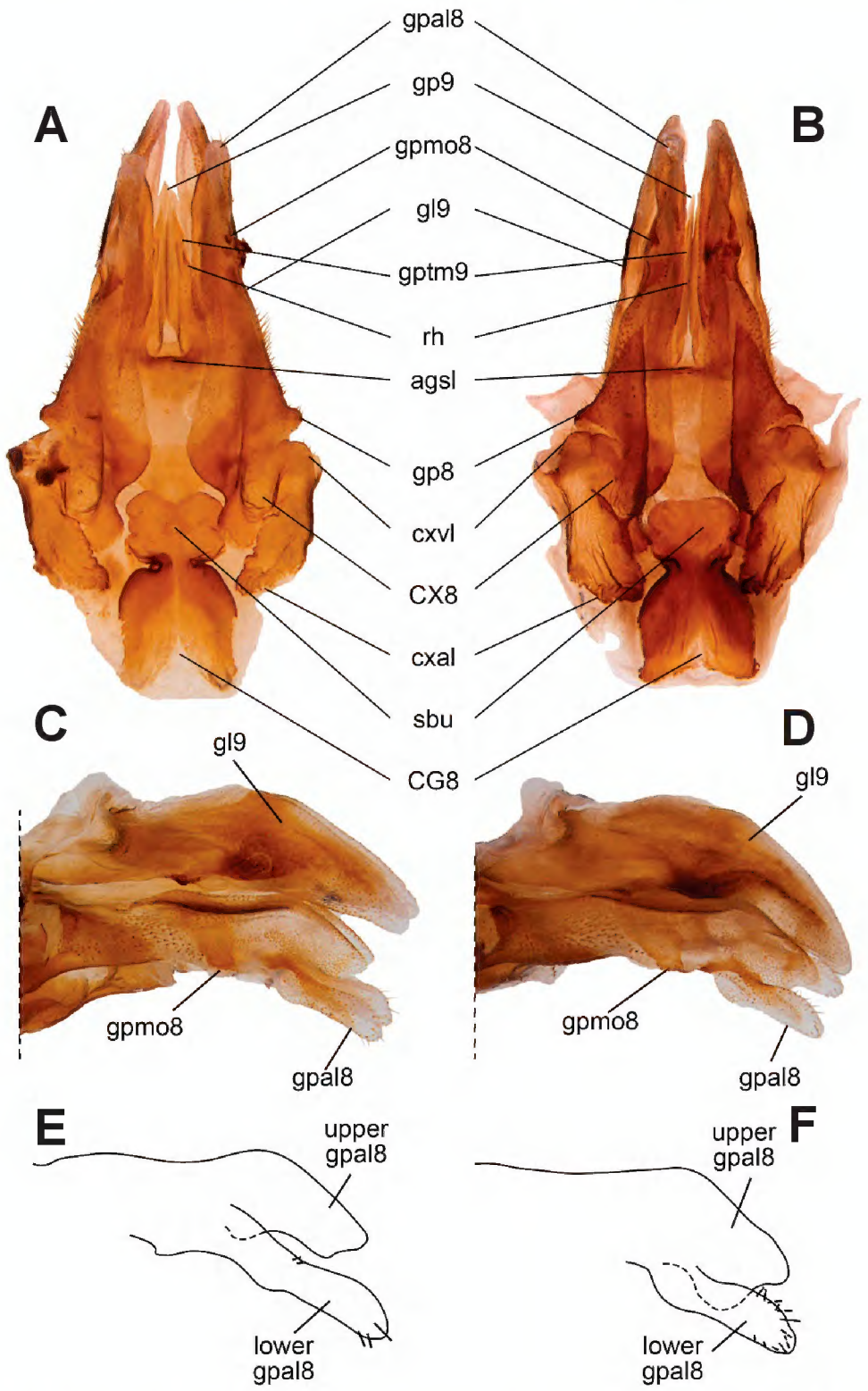

Fig. 6. Comparison of female genitalia of *Decimiana* species, *D. tessellata* and *D. hebardi*. **A.** *D. tessellata*, ventral view; **B.** *D. hebardi*, ventral view; **C.** *D. tessellata*, magnification of the distal area, lateral view; **D.** *D. hebardi*, magnification of the distal area, lateral view; **E.** Illustration of amplification of the apex of **gpal8** in *D. tessellata*; **F.** Illustration of amplification of the apex of **gpal8** in *D. hebardi*.

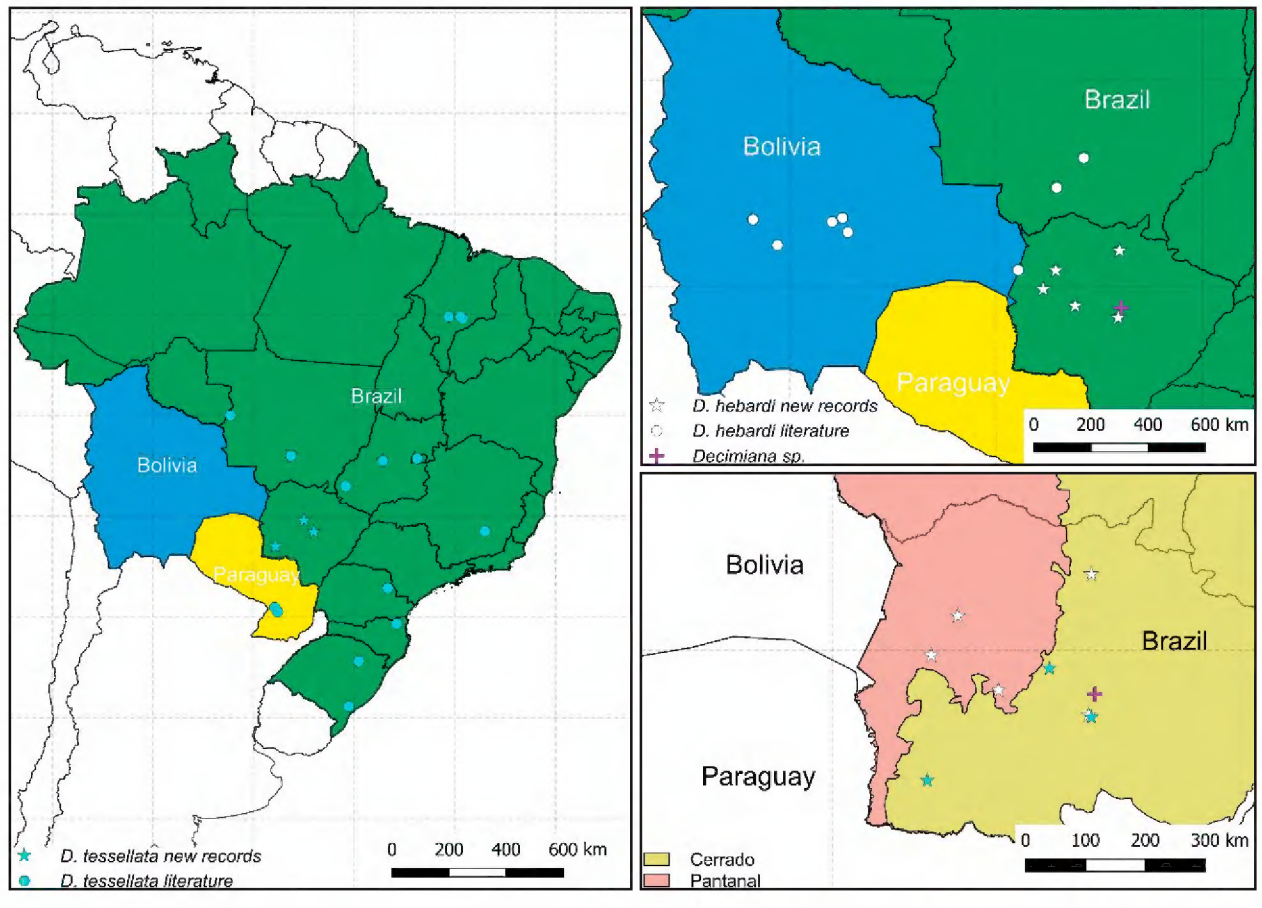

Fig. 7. Distributional map of the two species of *Decimiana*. Left, *D. tessellata*; Right, *D. hebardi*. Circles, records from literature; stars, new records; purple cross, nymph of unspecified *Decimiana*.

provide empirical evidence of the importance of female genitalia in praying mantis taxonomy and highlight the need for detailed descriptions when available to ensure comprehensive recognition of the taxa under investigation.

In the case of the two species of *Decimiana* discussed here, the delimitation of taxa is evident in the female genitalia, providing one more example of its taxonomic value. In *D. tessellata*, the proximal margin of the **CG8** is more deeply convex than in *D. hebardi*, creating a distinct structure profile. A similar pattern is observed in the **sbu** of *D. tessellata*, which is far more ornate, with a variable number of invaginations in its lateral margins, compared to the more homogeneous margins in *D. hebardi*. On the other hand, the margins of the **cxaI** and **CX8** are more wrinkled in *D. hebardi* than in *D. tessellata*. The inner area of the female genitalia in *D. tessellata* has a broader space, while in *D. hebardi*, this space is narrower, with the **CX8** and the **sbu** overlapping. The inner margin of the **gp8** in *D. tessellata* has a smooth sinuous profile, while it presents an almost straight profile in *D. hebardi*. The outer margin of the same structure is noticeably more sclerotized in *D. hebardi* than in *D. tessellata*. The **gpmo8** of *D. tessellata* is less developed vertically than in *D. hebardi*, although the **gl9** is wider in the latter. The **gpal8** exhibits a very peculiar profile in both species; after the **gpmo8**, the **gp8** bifurcates. In *D. tessellata*, the point of division occurs closer to the **gpmo8**. After bifurcation, the upper part is elongated with a squarer apex, while the lower part extends past the division point. In *D. hebardi*, the point of division occurs in the distalmost region, and after bifurcation, the upper part is also elongated but with a tapered outline, while the lower part does not extend far beyond the division point, presenting a rounded outline. Finally, the **gl9** in *D. tessellata* is narrower than in *D. hebardi*; in the latter, the **gl9** curves and ends closer to the apex of the **gpal8**, whereas it ends earlier in *D. tessellata*.

With the description of the female genitalia of these two species of *Decimiana*, a basis for comparisons between genera is beginning to be established. Favacho et al. (2023), Ferraz et al. (2023, 2025), and Ferraz and Souza-Dias (2025) have already illustrated and described the female genitalia of some species of *Pseudomiopteryx* Saussure, 1870, *Acontista* Saussure & Zehntner, 1894 and *Metaphotina* Piza, 1964 with high-resolution pictures. These works allow the comparison of female genitalia across close and distant taxa within Acanthopoidea and to source female genitalia characters for systematic and phylogenetic purposes. It is of the utmost importance that the report of female external and genital morphological characters in the description of praying mantis species becomes the standard procedure for Mantodea taxonomy. This is especially important in highly cryptic and sexually dimorphic taxa.

Although the occurrences recorded here are new records, they are not particularly surprising, as both species are documented in neighboring Brazilian states and/or countries (e.g., Mato Grosso, Goiás, Bolivia). However, large-scale collection biases present in entomological surveys have been identified for many arthropod groups (e.g., Andrade-Silva et al. 2022, Poester-Carvalho et al. 2023) and briefly discussed for Mantodea (Rivera and Vergara-Cobián 2017). Thorough surveys in Brazilian regions that lack collections of specimens will most probably result in new records, novel biological data, and undescribed species.

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References

Agudelo AA, Maldaner C, Rafael JA (2019) Dry leaf or twig mantis? A new genus and species of Acanthopidae with sexually dimorphic cryptic strategies (Insecta: Mantodea). Zootaxa 4560: 331–344. https://doi.org/10.11646/zootaxa.4560.2.6

Agudelo AA, Rivera J (2015) Some taxonomic and nomenclatural changes in American Mantodea (Insecta, Dictyoptera)—Part I. Zootaxa 3936: 335–356. https://doi.org/10.11646/zootaxa.3936.3.2

Agudelo AA (2014) A new genus and species of Mantoididae (Mantodea) from the Brazilian and Venezuelan Amazon, with remarks on *Mantoida* Newman, 1838. Zootaxa 3797: 194–206. https://doi.org/10.11646/zootaxa.3797.1.14

Andrade-Silva J, Baccaro FB, Prado LP, Guénard B, Warren DL, Kass JM, Economo EP, Silva RR (2022) A large-scale assessment of ant diversity across the Brazilian Amazon Basin: Integrating geographic, ecological, and morphological drivers of sampling bias. Ecography 2022: e06295. https://doi.org/10.1111/ecog.06295

Audinet-Serville JG (1831) Revue méthodique des insectes de l'ordre des Orthoptères. Annales des Sciences Naturelles 22: 28–65, 134–167, 262–292.

Brannoch SK, Svenson GJ (2016) Leveraging female genitalic characters for generic and species delimitation in *Nilomantis* Werner, 1907 and *Ilomantis* Giglio-Tos, 1915 (Mantodea, Nilomantinae). Insect Systematics & Evolution 47: 209–244. https://doi.org/10.1163/1876312X-47032141

Brannoch SK, Wieland F, Rivera J, Klass K-D, Béthoux O, Svenson GJ (2017) Manual of praying mantis morphology, nomenclature, and practices (Insecta, Mantodea). ZooKeys 696: 1–100. https://doi.org/10.3897/zookeys.696.12542

Bugnion E (1923) Mantes et empuses. Essais d'élevage. Appareil génital de la femelle. Confection de l'ootheque. Eclosion des jeunes larves. *Mantis religiosa*, *Empusa pennata*, *Gongylus gongylodes*. Mémoires de la Société Vaudoise des Sciences Naturelles 1: 177–243.

Charpentier T (1841) Einige Bemerkungen die Orthopteren betreffend, besonders in Bezug auf Burmeister's und Serville's Schriften über diese Insectenabtheilung. Zeitschrift für die Entomologie 3: 283–321.

Chopard L (1913) Description d'un genre nouveau et d'une espéce nouvelle de Mantidae (Orth.) de la République Argentine. Bulletin de la Société entomologique de France: 55–60. https://doi.org/10.5962/bhl.part.16268

Chopard L (1920) Recherches sur la conformation et le développement des derniers segments abdominaux chez les Orthoptères. Thèse de la Faculté des Sciences de Paris, Rennes, Oberthür. https://doi.org/10.5962/bhl.title.50305

Favacho CA, Agudelo AA, Carvalho-Filho FS (2023) Taxonomic review of *Pseudomiopteryx* Saussure, 1870 (Mantodea: Thespidae: Pseudomiopteryginae). Insect Systematics & Evolution 1: 1–45. https://doi.org/10.1163/1876312X-bja10047

Ferraz BR, Queiroga D, Souza-Dias PGB, Rivera J (2025) Taxonomic revision and natural history of *Metaphotina* Piza, 1964 (Mantodea, Acontistidae). Zootaxa 5646: 351–399. https://doi.org/10.11646/zootaxa.5646.3.3

Ferraz BR, Souza-Dias PGB (2025) Redescription of females of four species of the Neotropical dwarf mantis genus *Acontista* Saussure and Zehntner, 1894 (Mantodea: Acontistidae) and enhancement of diagnostic characters based in female genitalia. Journal of Natural History 56: 1353–1381. https://doi.org/10.1080/00222933.2025.2468674

Ferraz BR, Souza-Dias PGB, Rivera J (2023) A hidden gem from Northeastern Brazil: A remarkable new species of *Metaphotina* Piza, 1964 (Mantodea, Acontistidae) ecologically linked to the Caatinga. Zootaxa 5343: 31–54. https://doi.org/10.11646/zootaxa.5343.1.2

Giglio-Tos E (1915) Mantidi esotici. Bulletino della Società Entomologica Italiana 46: 31–108.

Goeze J (1778) Entomologische Beytrage zu des Ritter Linne zwolften Ausgabe des Natursystems. Leipzig, 352 pp. https://doi.org/10.5962/bhl.title.45974

Heitzmann TJ (1962) Estudo morfológico de *Acanthops falcataria* (Goeze, 1778) (Mantodea, Acanthopidae). Papéis Avulsos do Departamento de Zoologia 15: 201–222. https://doi.org/10.11606/0031-1049.1962.15.p201-221

Heitzmann-Fontenelle TJ (1964) Estudo Morfológico de *Acanthops erosula* Stål, 1877 (Mantodea, Acanathopidae). Papéis Avulsos do Departamento de Zoologia 16: 229–241.

Heitzmann-Fontenelle TJ (1965) *Acontiothespis concinna* (Perty, 1832) (Mantodea, Acontiothespinae): Descrição morfológica. Papéis Avulsos de Zoologia 17: 227–287. https://doi.org/10.11606/0031-1049.1965.17p277-289

Heitzmann-Fontenelle TJ (1968) *Acontiothespis brevipennis* (Saussure, 1871) (Perty, 1832) (Mantodea, Acontiothespinae): Descrição morfológica. Papéis Avulsos de Zoologia 21: 99–110. https://doi.org/10.11606/0031-1049.1968.21.p99-110

Heitzmann TJ (1959) Genitália de *Parastagmatoptera unipunctata* (Burm., 1838) (Mantodea). Papéis Avulsos de Zoologia 13: 329–337. https://doi.org/10.11606/0031-1049.1959.13.p329-337

Ippolito S, Lombardo F (2004) *Decimiana clavata*, new species from Brazil (Mantidae). Memorie della Società Entomologica Italiana 82: 373–378.

La Greca M, Rainone A (1949) Il dermascheletro e la muscolatura dell'addome di *Mantis religiosa*. Annuario dell'Istituto e Museo di Zoologia della Università di Napoli 1: 1–43.

Lombardo F (2000) A review of the genus *Decimiana* Uvarov, 1940 (Insecta: Mantodea), with description of a new species. Proceedings of the Academy of Natural Sciences of Philadelphia 150: 159–171.

Maldaner C, Rafael JA (2017) A new species of *Decimiana* Uvarov from Brazil, with usdpted key to species and remarks on their geographic distribution (Mantodea: Acanthopidae, Acanthopinae). Zootaxa 4291: 521–530. https://doi.org/10.11646/zootaxa.4291.3.5

Menezes E, Bravo F (2012) A new species of *Decimiana* Uvarov (Insecta, Mantodea, Acanthopidae) from Brazil, with remarks on the distribution of *Decimiana bolivari* (Chopard). ZooKeys 236: 55–64. https://doi.org/10.3897/zookeys.236.3477

Moulin N, Schwarz CJ (2023) Two new genera of Acanthopidae (Mantodea) from the Amazon region, with description of a new species. Zoosystema 45: 137–161. https://doi.org/10.5252/zoosystema-2023v45a5

Poester-Carvalho JA, Barão KR, da Costa LG, Ferrari A (2023) Areas of endemism and sampling bias of Pentatomidae (Heteroptera) in the Americas. Journal of Insect Conservation 27: 1–14. https://doi.org/10.1007/s10841-023-00497-5

Rivera J, Herculano JF, Lanna LM, Cavalcante S, Teixeira MLF (2020) A new species and first record of *Vates* Burmeister, 1838 from the Atlantic Rainforest (Mantodea: Vatinae). European Journal of Taxonomy 598: 1–25. https://doi.org/10.5852/ejt.2020.598

Rivera J, Svenson GJ (2020) The Neotropical Polymorphic Earless Praying Mantises: A taxonomic review of the genera and checklist of species. Thomas Say Publication in Entomology: Monographs, Annapolis, Maryland, 231 pp. https://doi.org/10.4182/QQHU9127

Rivera J, Vergara-Cobián C (2017) A checklist of the praying mantises of Peru: new records, one new genus (*Piscomantis* gen. n.) and biogeographic remarks (Insecta, Mantodea). Zootaxa 4337: 361–389. https://doi.org/10.11646/zootaxa.4337.3.3

Rivera J (2010) A historical review of praying mantid taxonomy and systematics in the Neotropical Region: State of knowledge and recent advances (Insecta: Mantodea). Zootaxa 2638: 44–64. https://doi.org/10.11646/zootaxa.2638.1.3

Rodrigues HM, Cancello EM (2016) Taxonomic revision of *Stagmatoptera* Burmeister, 1838 (Mantodea: Mantidae, Stagmatopterinae). Zootaxa 4183: 1–78. https://doi.org/10.11646/zootaxa.4183.1.1

Roy R (2004) *Lagrecacanthops* et *Miracanthops*, deux nouveaux genres d'Acanthopinae (Dictyoptera, Mantodea, Acanthopidae). Bulletin de la Sicuété entomologique de France 109: 491–498. https://doi.org/10.3406/bsef.2004.16164

Roy R (2006) Vue d'ensemble sur les Acontistinae Giglio-Tos, 1919 (Dictyoptera, Acanthopidae). Bulletin de la Société Entomologique de France 111: 327–338. https://doi.org/10.3406/bsef.2006.16331

Saussure H (1870) Additions au système des Mantides. Mitteilungen der Schweizerischen Entomologischen Gesellschaft 3: 221–244.

Saussure H, Zehntner L (1894) Fam. Mantidae. In Biologia Centrali-Americana. Insecta. Orthoptera 1: 123–197.

Scherrer MV (2014) A revision of *Miobantia* Giglio-Tos, 1917 (Mantodea: Thespidae, Miobantiinae), with molecular association of dimorphic sexes and immature stages. Zootaxa 3797: 207–268. https://doi.org/10.11646/zootaxa.3797.1.15

Schwarz CJ, Roy R (2019) The systematics of Mantodea revisited: an updated classification incorporating multiple data sources (Insecta: Dictyoptera). Annales de la Société entomologique de France (N.S.) 55: 101–196. https://doi.org/10.1080/00379271.2018.1556567

Stål C (1877) Systema mantodeorum. Essai d'une systématisation nouvelle des Mantodées. Bihang till Kongliga Svenska Vetenskaps-Akademiens Handlingar, v. 4: 1–91.

Svenson GJ, Rodrigues HM (2019) A novel form of wasp mimicry in a new species of praying mantis from the Amazon rainforest, *Vespamantoida wherleyi* gen. nov. sp. nov. (Mantodea, Mantoididae). PeerJ 7: e7886. https://doi.org/10.7717/peerj.7886

Svenson GJ (2014) Revision of the Neotropical bark mantis genus *Liturgusa* Saussure, 1869 (Insecta, Mantodea, Liturgusini). ZooKeys 390: 1–214. https://doi.org/10.3897/zookeys.390.6661

Uvarov BP (1940) Two new Acrididae from Afghanistan. Annals and Magazine of Natural History 6: 54–59. https://doi.org/10.1080/03745481.1940.9723656

Werner F (1907) Ergebnisse der mit Subvention aus der Erbschaft Treitl unternommenen zoologischen Forschungsreise Dr. Franz Werner's in den ägyptischen Sudan und nach Nord-Uganda: Orthoptera Blattaeformia. VII. aus der Kaiserlich-Königlichen Hof-und Staatsdruckerei. In Kommission bei Alfred Hölder, Vienna.